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Role of Growing Media on Seedling Vigor of Tomato

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ABSTRACT

Robust seedlings are the most important inputs for getting a good crop with high yield and quality. Tomato seedlings raised in plugtrays are considered better than those raised in conventional nursery, but the media on which they are raised determine the seedling vigor and quality. Therefore, the effect of various media, viz., sand, soil, vermicompost and cocopeat and their combinations in different ratio (volume/volume) on the seedlings of tomato variety Kashi Vishesh raised in plugtrays was studied. Germination percent, shoot length, root length, seedling length, seedling fresh weight and seedling vigor index-I and seedling vigor index-II were highest when seeds were sown in the media consisting of sand+ vermicompost+cocopeat at 1:1:1 ratio, whereas days to seedling germination/emergence was least when sown in only sand. T_{14} (sand+vermicompost+ cocopeat at 1:1:1 ratio) growing media was found to be the best growing medium for seed germination and seedling vigor characteristics and this media could be effectively used for seedling raising in plugtrays.

Keywords Tomato, Plugtray nursery, Growing media, Germination, Vigorus seedling.

INTRODUCTION

Tomato (*Solanum lycopersicum* L.), is an annual herbaceous plant belonging to the Solanaceae family, and botanically a tomato is the matured ovary of a flowering plant together with its seeds, and therefore it is a true fruit, a berry. Though botanically it is a fruit, horticulturally it is a vegetable (Benor *et al.* 2008). It is commonly known as "Protective food" due to its phytonutrient contents. Tomato ranks first among the processed vegetables. It is also a good source of income to small and marginal farmers. The increase in the area of production and value has increased the economic significance of the crop worldwide (Albaho *et al.* 2009). Tomato is a popular vegetable of the world and its acreage is 5.41 million ha, production is 192.32 million tonnes and productivity are 35.53 tons/ha (FAOSTAT 2023). China is the leading producer of tomato followed by India, Turkey, USA and Egypt (FAOSTAT 2023). In India, the area, production

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and productivity of the crop is about 0.849 million hectares, 20.425 million tonnes and 24.06 tonnes per hectare respectively (FAOSTAT 2023).

Tomato is usually grown as a transplanted crop. It is sown in nursery and transplanted in the main field when healthy and vigorus seedlings attain 12–15 cm height with 3–4 true leaves. The health and vigor of the tomato seedlings is a determining factor of the yield that can be achieved. Seed germination is of utmost importance since the rate of germination influences the seedling growth rate, the final population of the crop and the rest of the plant life including potential yield (Ghaleb *et al*. 2022). This is followed by the seedling vigor. The medium of seedling raising is the major factor affecting the germination / emergence of the seeds, as well as the seedling growth and quality (Aklibasinda *et al.* 2011). Protray or plugtrays grown seedlings have been found to have earlier germination, efficient root growth, thereby resulting in vigorus seedlings. These portray-grown nursery has higher transplanting efficiency and may regularize the supply of quality seedlings of various crops, particularly vegetables. The media used for raising the seedlings play an important role in germination of seeds and the growth process of the seedlings thereafter, and hence becomes a determining factor of seedling vigor. Hence, this study was taken up to find out the role of various commonly available media and their combinations used in seedling raising on the vigor of the seedlings.

MATERIALS AND METHODS

The research was carried out at the Vegetable Research Farm, Bihar Agricultural College, Bihar Agricultural University, Sabour, Bhagalpur to see the effect of growing media (sand, soil, vermicompost, cocopeat and their combination in different ratio) for vigorus tomato seedling. The seeds of tomato variety Kashi Vishesh (H-86) were used for the investigation. The experiment was conducted in Completely Randomized Design (CRD) which consisted of sixteen treatments of various media singly or in combination in different ratio and for each treatment, there were three replications. The media was prepared in volume-by-volume ratio and was completely filled in each cell of portray and then one seed was sown in each cell. After seed sowing, watering of the trays was done at regular intervals, starting from the day of sowing to uprooting.

The 16 treatments consisted of sand only (T_1), soil only (T_2), cocopeat only (T_3), vermicompost only (T_4), sand and soil in 1:1 ratio (T_5), sand and vermicompost in 1:1 ratio (T_6), sand and cocopeat in 1:1 ratio (T_7), sand and cocopeat in 2:1 ratio (T_8), soil and vermicompost in 1:1 ratio (T_9), soil and cocopeat in 1:1 ratio (T_{10}), soil and cocopeat in 2:1 ratio (T_{11}), vermicompost and cocopeat in 1:1 ratio (T_{12}), vermicompost and cocopeat in 2:1 ratio (T_{13}), sand, vermicompost and cocopeat in 1:1:1 ratio (T_{14}), soil, vermicompost and cocopeat in 1:1:1 ratio (T_{15}), sand, soil and vermicompost in 1:1:1 ratio (T_{16}).

Germination percent, days to seedling emergence were recorded and after 25 days from sowing, the seedlings was removed manually from each cell of portray and all the seedling growth parameters and vigor parameters were recorded.

RESULTS AND DISCUSSION

Analysis of variance revealed the presence of significant variation among all the treatments under study for all the characters studied. The study revealed that there was a significant difference between seedling germination percentage among different growing media, which is shown in Table 1.

Seed germination percentage was highest in the media containing sand + vermicompost + cocopeat @ 1:1:1 (T_{14}) which was statistically similar or at par with T_3 (only cocopeat 90%), T_8 (sand+ cocopeat @ 2:1, 90%) and T_{12} (vermicompost + cocopeat @ 1:1, 93.33%). The least germination percentage (65%) was found in T_{16} (sand + soil + vermicompost 1:1:1, 53.31%). Growth medium promotes water absorption, nutrient availability and supply of oxygen to the germinating seeds and seedlings which favor the germination of seeds. Cocopeat enhances porosity of the media and reduce its compactness that favor high germination of seed.

There was significant difference between seedling emergence among different growth medium.

Table 1. Seed germination and seedling traits of tomato variety Kashi Vishesh raised on various media.

Treatments	Treatment details	Germination percentage (%)	Days to seedling emergence	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Shoot root ratio
T_1	Only sand	86.67	4.54	5.00	3.78	8.77	1.32
T_2	Only soil	80.00	8.61	6.25	4.37	10.61	1.43
T_3	Only cocopeat	90.00	5.86	8.41	9.15	17.56	0.94
T_4	Only vermicompost	86.67	7.32	10.55	9.86	20.41	1.07
T_5	Sand + Soil (1:1)	80.00	7.49	9.08	7.19	16.26	1.26
T_6	Sand + Vermicompost (1:1)	66.67	6.47	8.64	8.54	17.18	1.01
T_7	Sand + Cocopeat (1:1)	63.33	8.13	8.46	10.34	18.80	0.82
T_8	Sand + Cocopeat (2:1)	90.00	6.57	11.73	7.86	19.60	1.49
T_9	Soil + Vermicompost (1:1)	53.33	7.05	9.67	5.52	15.19	1.75
T_{10}	Soil + Cocopeat (1:1)	70.00	6.30	9.80	7.14	16.94	1.38
T_{11}	Soil + Cocopeat (2:1)	86.67	7.96	11.66	8.38	20.04	1.40
T_{12}	Vermicompost + Cocopeat (1:1)	93.33	7.86	12.32	10.25	22.57	1.20
T_{13}	Vermicompost + Cocopeat (2:1)	86.67	8.74	11.27	8.57	19.84	1.32
T_{14}	Sand + Vermicompost + Cocopeat (1:1:1)	96.67	6.61	15.14	14.14	29.28	1.07
T_{15}	Soil + Vermicompost + Cocopeat (1:1:1)	90.00	7.29	12.10	10.35	22.45	1.17
T_{16}	Sand + Soil + Vermicompost (1:1:1)	80.00	8.68	13.28	9.57	22.85	1.39
	SEm (±)	5.77	0.21	0.36	0.29	0.38	0.06
	CD (p=0.05)	16.63	0.60	1.05	0.83	1.09	0.18

Table 1. Continued.

Treatments	Treatment details	Shoot diameter (mm)	Seedling fresh weight (g)	Seedling dry weight (g)	Seedling vigor index I	Seedling vigor index II
T_1	Only sand	0.86	0.34	0.09	760.35	7.82
T_2	Only soil	1.02	0.52	0.15	849.16	12.02
T_3	Only cocopeat	2.00	1.13	0.21	1580.20	19.21
T_4	Only vermicompost	1.63	1.21	0.26	1770.12	22.51
T_5	Sand + Soil (1:1)	1.67	1.17	0.29	1302.57	23.63
T_6	Sand + Vermicompost (1:1)	1.98	1.17	0.24	1146.86	15.92
T_7	Sand + Cocopeat (1:1)	1.50	0.79	0.13	1188.90	8.14
T_8	Sand + Cocopeat (2:1)	1.25	1.25	0.37	1762.93	33.40
T_9	Soil + Vermicompost (1:1)	1.32	1.20	0.42	811.82	22.52
T_{10}	Soil + Cocopeat (1:1)	1.32	1.05	0.29	1190.45	20.16
T_{11}	Soil + Cocopeat (2:1)	2.02	1.92	0.54	1736.27	46.57
T_{12}	Vermicompost + Cocopeat (1:1)	1.89	1.74	0.42	2106.26	39.20
T_{13}	Vermicompost + Cocopeat (2:1)	1.74	1.55	0.41	1719.76	35.27
T_{14}	Sand + Vermicompost + Cocopeat (1:1:1)	2.29	2.44	0.52	2833.16	50.61
T_{15}	Soil + Vermicompost + Cocopeat (1:1:1)	1.95	1.74	0.41	2022.79	36.77
T_{16}	Sand + Soil + Vermicompost (1:1:1)	2.03	2.19	0.61	1815.47	49.14
	SEm (±)	0.05	0.04	0.01	109.87	2.70
	CD (p=0.05)	0.15	0.12	0.04	316.49	7.77

Observance of data showed that the early seedling emergence was obtained growing media T_1 (only sand) which was 4.54 days after sowing whereas the late seedling emergence was observed in the growing media T_{13} (vermicompost+ cocopeat @ 2:1) which was 8.74 days after sowing. Similar findings in tomato were also reported by Sahni *et al.* (2008).

Observance of data showed that the maximum shoot length was obtained in plants of interaction T_{14} (sand+ vermicompost+ cocopeat @ 1:1:1) which was 15.14 cm whereas the minimum shoot length was recorded in the plants of interaction T_1 (only sand) which was 4.42 cm. The earlier works of Vivek and Duraisamy (2017), Awang *et al.* (2009) and Abad *et al.* (2005) support our findings.

The effect of different growing media on seedling parameters has been shown in Table 1. Examination of the data indicates that the highest root length was achieved by plants in the growing media T_{14} (sand+ vermicompost + cocopeat @ 1:1:1) which was 14.14 cm. Conversely, the lowest root length was observed in T_1 (only sand) with a 3.35 cm. The study revealed the different growing media played an important role in root growth and there was difference in root length in different growing media. Vermicompost has been found to be provide sufficient nutrients to the media, besides enhancing its porosity, aeration and water holding capacity (Rehman *et al.* 2023) and thereby influencing the oxygen availability of the roots, and being an excellent plant growth promoter (Coria-Cayupaán *et al.* 2009, Jeevitha *et al.* 2019).

Significant difference in seedling length when raised on different growth medium was observed. The highest seedling length was obtained in plants of growing media T_{14} (sand+ vermicompost+ cocopeat @1:1:1) which was 29.28 cm whereas the minimum seedling length was observed in the plants of growing media T_1 (only sand) which was 8.77 cm. This was probably because the media was sufficiently porous due to sand and cocopeat helping root growth, with good water holding capacity due to vermicompost and cocopeat that also enhanced root development, which was in accordance with Rehman *et al.* (2023).

The study revealed that there was significant difference in shoot : Root ratio among different growing medium, as represented in Table 1. Examination of data showed that the highest shoot to root ratio was obtained in plants of interaction T_9 (soil+ vermicompost @ 1:1) which was 1.75 whereas the minimum shoot to root ratio was observed in the growing media T_7 (sand+ cocopeat 1:1) which was 0.82. The shoot to root ratio is the amount of plant tissues that have supportive functions to the amount of those that have growth functions. Plants having higher proportion of roots can compete more effectively for soil nutrients, while higher proportion of shoots can collect more light energy. Shoot production are characteristic of vegetation in early successional phases, while high proportions of root production are characteristic of climax vegetation phases (Alam *et al.* 2020).

The highest shoot diameter was obtained in plants of growing media T_{14} (sand+ vermicompost+ cocopeat) which was 2.29 mm whereas the minimum shoot diameter was observed in the growing media T_1 (only sand) which was 0.86 mm. The results are in consonance with the finding of Gama *et al.* (2015), Alam *et al.* (2020). Combined application of vermicompost and cocopeat in the media showed more stem diameter probably due to the synergistic combinations of these factors improving the physical conditions of the media and nutritional factors (Sahni *et al.* 2008). It may be due to better nutrient availability leading to higher production of photosynthetically functional leaves in this treatment finally resulting in better girth of seedling. Similar results were also obtained by Parasana *et al*. (2013).

The highest seedling fresh weight was obtained in plants of growing media T_{14} (sand+ vermicompost+ cocopeat @ 1:1:1) which was 2.44 g whereas the minimum seedling fresh weight was observed in the plants T_1 (only sand) which was 0.15 g. The results are in consonance with the finding of Jeevitha *et al.* (2019).

The highest seedling dry weight was obtained in plants of interaction T_{16} (sand+ soil+ vermicompost @ 1:1:1) which was 0.61 g whereas the minimum seedling dry weight was observed in the plants of growing media T_1 (only sand) which was 0.04 g. The accumulation of dry weight in the early stage of seed-

ling in larger seed is due to a result of mobilization of storage reserve from cotyledons. Similar findings were also reported by Gama *et al.* (2015).

The study revealed that there was significant difference between seed vigor index among seedlings raised in different growing media. Observance of data showed that the highest seedling vigor index-1 was obtained in plants of growing media T_{14} (sand+ vermicompost+ cocopeat 1:1:1) which was 2833.16 whereas the minimum seedling vigor index-1 was observed in the plants T_{16} (sand + soil + vermicompost @1:1:1) which was 578.3. High seed vigor index in bio-bacterial compost is due to high phosphorus content. Larger seeds were found to have higher seed vigor index. Increased seed vigor index in larger seed might be due to presence of higher amount of carbohydrate and other nutrients.

The highest seedling vigor index-2 was obtained in plants of growing media T_{14} (sand+ vermicompost+ cocopeat) which was 50.61 whereas the minimum seedling vigor index-2 was observed in the plants T_1 (only sand) which was 3.34. Similar findings were also reported by Demisie *et al.* (2019), Atif *et al.* (2016), Jeevitha *et al*. (2019). Seedling vigor index was influenced significantly with the use of growing media and plant growth regulators, and the seedling showing the higher seedling vigor index is considered to be more vigorus (Abdul-Baki and Anderson 1973).

CONCLUSION

Significant variations were observed among different growing medium with respect to seed germination percentage, days to seedling emergence, shoot length, root length, shoot diameter, seed vigor index, shoot to root length ratio, dry weight and plant height when seeds of tomato variety Kashi Vishesh were raised in plugtrays using different media combinations. The media composed of sand, vermicompost and cocopeat in 1:1:1 volume/volume ratio could be identified as the best growing medium for seed germination and seedling vigor characteristics and this media could be effectively used for tomato seedling raising in plugtrays.

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REFERENCES

Abad, M., Fornes, F., Carrión, C., Noguera, V., Noguera, P., Maquieira, A., & Puchades, R. (2005). Physical properties of various coconut coir dusts compared to peat. *Hort Science*, 40 (7), 2138— 2144.

Abdul-Baki, A. A., & Anderson, J. D. (1973). Vigor Determination in Soybean Seed by Multiple Criteria. *Crop Science*, 13, 630—633.

Aklibasinda, M., Tunc, T., Bulut, Y., & Sahin, U. (2011). Effects of different growing media on Scotch pine (*Pinus sylvestris*) production. *Journal of Animal and Plant Sciences*, 21 (3), 535—541.

Alam, M., Hussain, Z., Ullah, Z., Samiullah Ahmad, I., Asif, M., Shah, M. A., Shah, S. Q. A., & Khan, J. R. (2020). Effect of growing media on rooting response of tomato (*Lycopersicum esculentum* L) stem cuttings. *Pure and Applied Biology*, 9 (1), 884—896.

Albaho, M., Bhat, N., Abo-Rezq, H., & Thomas, B. (2009). Effect of three different substrates on growth and yield of two cultivars of *Capsicum annuum*. *European Journal of Sciences & Research*, 28 (2), 227—233.

Atif, M. J., Jellani, G., Malik, M. H. A., Saleem, N., Ullah, H., Khan, M. Z., & Ikram, S. (2016). Different Growth Media Effect the Germination and Growth of Tomato Seedlings. *Science*, *Technology and Development*, 35 (3), 123—127.

Awang, Y., Shaharom, A. S., Mohamad, R. B., & Selamat, A. (2009). Chemical and physical characteristics of cocopeat-based media mixtures and their effects on the growth and development of *Celosia cristata*. *American Journal of Agricultural and Biological Sciences*, 4 (1), 63—71.

Benor, S., Zhang, M., Wang, Z., & Zhang, H. (2008). Assessment of genetic variation in tomato (*Solanum lycopersicum* L.) inbred lines using SSR molecular markers. *Journal of Genetics and Genomics*, 35 (6), 373—379.

Coria-Cayupaán, Y. S., de Pinto, M. A. I. S., & Nazareno, M. A. (2009). Variations in bioactive substance contents and crop yields of lettuce (*Lactuca sativa* L.) cultivated in soils with different fertilization treatments. *Journal of Agriculture & Food Chemistry*, 57, 10122—10129.

Demisie, W., Mengistu, T., & Kindie, A. (2019). International Journal of Advanced Scientific Research & Development, 6 (9), 01—07.

F.A.O.S.T.A.T. (2023). Food and agriculture data, Food and Agricultural Organization of the United Nations. https://www.fao.org/faostat/en/#data/QCL accessed on 23rd July 2025.

Gama, P. B. S., Wani, L. B., d'Ragga, P. W. M., & Misaka, B. C. (2015). Effect of Soil Media on Growth of Tomato Seedlings (*Solanum lycopersicum* L.) under nursery (Greenhouse)

Conditions. *International Journal of Agricultural Research and Review*, 3 (10), 432—439.

Ghaleb, W., Ahmed, L. Q., Wagner, M. H., Eprinchard-Ciesla, A., Olivares-Rodríguez, W. E., Perrot, C., Chenu, K., Norton, M., & Escobar-Gutiérrez, A. J. (2022). The Concepts of Seed Germination Rate and Germinability: A Re-Evaluation for Cool-Season Grasses. *Agronomy*, 12, 1291. https://doi.org/10.3390/agronomy12061291.

Jeevitha, J., Rajalingam, G.V., Arumuga, T., & Sellamuthu, K. M. (2019). Effect of growing media on tomato seedling production. *International Journal of Chemical Studies*, 7 (4), 319—321.

Parasana, J. S., Leua, H. N., & Ray, N. R. (2013). Effect of different growing medias mixture on the germination and seedling growth of mango (*Mangifera indica*) cultivars under net house conditions. *The Bioscan*, 8 (3), 897—900.

Rehman, S. U., De Castro, F., Aprile, A., Benedetti, M., & Fanizzi, F. P. (2023). Vermicompost: Enhancing Plant Growth and Combating Abiotic and Biotic Stress. *Agronomy*, 13 (4), 1134. https://doi.org/10.3390/agronomy13041134

Sahni, S., Sharma, B. K., Singh, D. P., Singh, H.P., & Singh, K.P. (2008). Vermicompost enhances performance of plant growth promoting rhizobacteria in *Cicer arietinum* rhizosphere against *Sclerotium rolfsii*. *Crop Protection*, 27, 369—376.

Vivek, P., & Duraisamy, V. (2017). Study of growth parameters and germination on tomato seedlings with different growth media. *International Journal of Agricultural Sciences*, 7, 461—470.